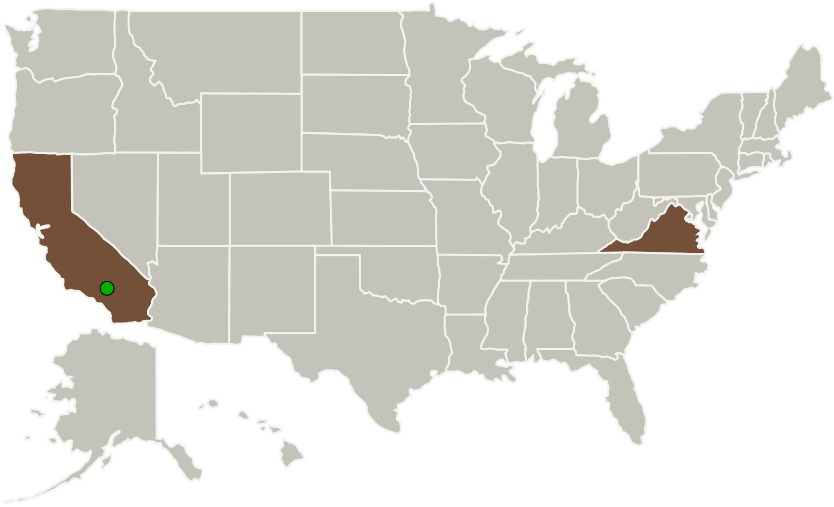
Embedded Fiber Optic Shape Sensing for Aeroelastic Wing Components, Phase I

Completed Technology Project (2012 - 2013)

Project Introduction

As the aerospace industry continues to push for greater vehicle efficiency, performance, and longevity, properties of wing aeroelasticity and flight dynamics have become increasingly important. Both the study and the active control of wing dynamics require advanced sensing technology to inform the design process on the ground and provide feedback for aeroservoelastic systems in the sky. Existing aeroelastic monitoring systems rely on large networks of individual strain sensors, which must be precisely mapped to the wing's surface, and from which dynamic wing shape can only be inferred from the synthesis of their strain measurements. To date, no technology has been demonstrated which can make a true measurement of distributed wing shape using a single embedded sensor. Luna Innovations, Inc. proposes to leverage its ongoing fiber optic shape sensing development effort to create a unique technology capable of measuring wing geometry and vibration in response to gusts, static or dynamic loading, and aeroservoelastic control. In partnership with Dr. Rakesh Kapania, Professor of Aerospace Engineering at Virginia Tech, Luna will design a model-based sensor layout, embed their miniature fiber optic shape sensing technology in an idealized flexible wing model, and demonstrate the feasibility of the technology in a wind tunnel environment.

Primary U.S. Work Locations and Key Partners



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Organizations Performing Work	Role	Type	Location
Luna Innovations, Inc.	Lead Organization	Industry	Roanoke, Virginia
Armstrong Flight Research Center(AFRC)	Supporting Organization	NASA Center	Edwards, California
Virginia Polytechnic Institute and State University(VA Tech)	Supporting Organization	Academia	Blacksburg, Virginia

Primary U.S. Work Locations	
California	Virginia

Project Transitions

February 2012: Project Start

February 2013: Closed out

Closeout Documentation:

- Final Summary Chart*(https://techport.nasa.gov/file/138127)*

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Luna Innovations, Inc.

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

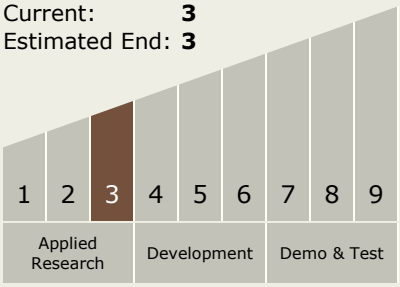
Carlos Torrez

Principal Investigator:

Evan Lally

Technology Maturity (TRL)

Start: **3**
Current: **3**
Estimated End: **3**



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Technology Areas

Primary:

- TX15 Flight Vehicle Systems
  - TX15.1 Aerosciences
    - TX15.1.3 Aeroelasticity

Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System